Performance Evaluation of Roughened Solar Air Heaters for Stretched Parameters

Artificial roughness applied to a Solar Air Heater (SAH) absorber plate is a popular technique for increasing its total thermal efficiency (ηt−th). In this paper, the influence of geometrical parameters of V-down ribs attached below the corrugated absorbing plate of a SAH on the ηt−th was examined. The impacts of key roughness parameters, including relative pitch p/e (6–12), relative height e/D (0.019–0.043), angles of attack α (30–75◦), and Re (1000–20,000), were examined under real weather conditions. The SAH ηt−th roughened by V-down ribs was predicted using an in-house developed conjugate heat-transfer numerical model. The maximum SAH ηt−th was shown to be 78.8% as predicted under the steady-state conditions of Re = 20,000, solar irradiance G = 1000 W/m2 , p/e = 8, e/D = 0.043, and α = 60. The result was 15.7% greater efficiency compared to the default smooth surface. Under real weather conditions, the ηt−th of the roughened SAH with single- and double-glass covers were 17.7 and 20.1%, respectively, which were higher than those of the smooth SAH